

ORIGINAL ARTICLE

Taxonomic notes on Hydroidomedusae (Cnidaria) from South China Sea II: Family Bythotiaridae (Anthomedusae)

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Abstract This paper includes new data on Bythotiaridae (Anthomedusae), *Protiaropsis pedunculata* Xu, Huang & Guo, **sp. nov.** and *P. tetranema* Xu, Huang & Wang, **sp. nov.** are described. An additional two genera and species: *Eumedusa* sp. and *Sibogita geometrica* Mass, 1905 are recorded from Chinese waters for the first time. The species *Bythotiara depressa* Naumov, 1960 is redescribed and its relationship to *Protiaropsis anonyma* (Maas, 1905) is discussed. Other data are briefly summarized to the list of species presented on the family Bythotiaridae in South China Sea. The type specimens were deposited at the Third Institute of Oceanography, State Oceanic Administration.

Key words Bythotiaridae, new species, new recorded genera, South China Sea.

1 Introduction

The inshore fauna of the Bythotiaridae (medusa stage) from South China Sea is fairly well documented (Xu *et al.*, 2014). However, there are few published data on the deep water fauna from South China Sea and adjacent waters of the eastern China Sea. Recent collections have provided specimens of such offshore medusa. The present paper used these materials to update the Bythotiaridae of our previous monograph. A total of 10 medusa species of family Bythotiaridae were identified in this work, two of which are new to science. Two genera and species are reported from Chinese waters for the first time.

Based on previous reports (Xu & Zhang, 1978; Li & Chen, 1991; Xu & Huang, 1994, 2006; Xu *et al.*, 2008; Du *et al.*, 2012) and recent records of the authors, there are 17 medusa species including *incertae sedis* and 9 genera of Bythotiaridae in China Sea (see List of Bythotiaridae).

2 Materials and methods

The samples were collected mostly from stations (04°00'–18°30'N, 109°00'–119°00'E) in median and southern of South China Sea during June to August, 2012, partly from Beibu Gulf, northern of South China Sea (17°04'–21°34'N, 107°24'–110°06'E) during July 2006 and January 2007, and supplied by the Fisheries Research Institute of East China Sea. All planktonic samples were collected by vertical tows from the bottom to the surface with a maximum sampling depth of 200 m using a large-type zooplankton net (80 cm diameter, 0.505 mm mesh size) and WP2 zooplankton net (57 cm diameter,

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0.202 mm mesh size).

Specimens were fixed in 5% formaldehyde buffered in seawater, and examined by stereoscopic and light microscopy. All drawings were made from preserved specimens using an attached camera lucida. Microphotographs were taken using an Axiocam MRe5 (Zeiss). Type specimens are deposited in the Third Institute of Oceanography, State Oceanic Administration.

3 Taxonomy

List of species presented on the family Bythotiaridae in China Sea.

Class Hydroidomedusa Claus, 1877

Subclass Anthomedusae Haeckel, 1879

Order Filifera Kühn, 1913

Suborder Pandeida Haeckel, 1879

Family Bythotiaridae Maas, 1905

Genus *Bythocellata* Nair, 1951

Bythocellata bulbiformis Xu & Huang, 2006

Bythocellata cruciformis Nair, 1951

Genus *Bythotiara* Günther, 1903

Bythotiara apicigastera Xu, Huang & Guo, 2008

Bythotiara depressa Naumov, 1960

Bythotiara murrayi Günther, 1903

Genus *Calycopsis* Fewkes, 1882

Calycopsis bigelowi Vanhöffen, 1911

Calycopsis papillata Bigelow, 1918

Genus *Eumedusa* Bigelow, 1920

Eumedusa sp.

Genus *Gymnogonium* Xu & Huang, 1994

Gymnogonium zhengzhongii Xu & Huang, 1994

Genus *Protiaropsis* Stechow, 1919

Protiaropsis anonyma (Maas, 1905)

Protiaropsis minor (Vanhöffen, 1911)

Protiaropsis pedunculata Xu, Huang & Guo, **sp. nov.**

Protiaropsis tetranema Xu, Huang & Wang, **sp. nov.**

Genus *Pseudotiara* Bouillon, 1980

Pseudotiara octonema Xu, Huang & Guo, 2008

Pseudotiara tropica (Bigelow, 1912)

Genus *Sibogita* Maas, 1905

Sibogita geometrica Maas, 1905

Family Bathotiaridae *incertae sedis*

Genus *Kanaka* Uchida, 1947

Kanaka pelagica Uchida, 1947

Bythotiaridae Maas, 1905

Bythotiaridae Bouillon *et al.*, 2006: 178; Schuchert, 2009: 442.

Bythotiaridi Mayer, 1910: 183.

Diagnosis. Medusae without apical projection, marginal bulbs very indistinct or absent; four, eight or more hollow marginal tentacles, each terminating in a large swelling covered by nematocysts, basal portion of tentacles usually adnate to exumbrella; with or without rudimentary or dwarf solid tentacles; four or eight radial canals, simple or branching, with or without centripetal canals growing from circular canal towards centre; with or without gastric peduncle; mouth with four simple or crenulated lips; gonads on manubrium wall, simple or horizontally folded, adradial or interrarial; rarely abaxial ocelli on tentacle bases.

Remarks. Bouillon *et al.* (2006) provided more details and a key to all genera. The subdivision of the family in genera is not well resolved and progress is hampered by the fact that many polyp stages of this family remain unknown. The distinction between *Protiaropsis anonyma* Maas, 1905 and *Bythotia depressa* Naumov, 1960 is clarified. The family name Bythotiaridae Maas, 1905 has priority over Calycopsidae Hartlaub, 1913 (Brinckmann-Voss & Arai, 1998).

Key to the genera of Bythotiaridae medusae of South China Sea.

1. Centripetal canals present, blindly ending or joining base of manubrium.....2
Without centripetal canals.....3
2. All tentacles hollow; cnidocysts only in the terminal knob.....*Calycopsis* Fewkes, 1882
Two kinds of tentacles, large, hollow, with rings of cnidocysts and a terminal knob, and small, solid dwarf tentacles without terminal knob.....*Eumedusa* Bigelow, 1920
3. Radial canals simple, unbranched.....4
Radial canals branched; gonads folded or smooth.....6
4. Gonads smooth adradial.....*Pseudotiara* Bouillon, 1980
Gonads smooth interradial.....5
5. 8 radial canals; marginal tentacles with abaxial basal ocelli.....*Bythocellata* Nair, 1951
4 radial canals; no ocelli.....*Protiaropsis* Stechow, 1919
6. Radial canals branching repeatedly at various levels.....*Sibogita* Maas, 1905
Radial canals simple or bifurcated.....7
7. 4 radial canals simple or bifurcated; gonads interradial, with transverse furrows; marginal bulbs absent.....*Bythotira* Günther, 1903
2 simple and 2 bifurcated radial canals; gonads smooth perradial; marginal tentacles with basal swellings embedded in mesoglea.....*Gymnogonium* Xu & Huang, 1994

Bythotia Günther, 1903

Bythotia n. g. Günther, 1903: 424; Schuchert, 2009: 443.

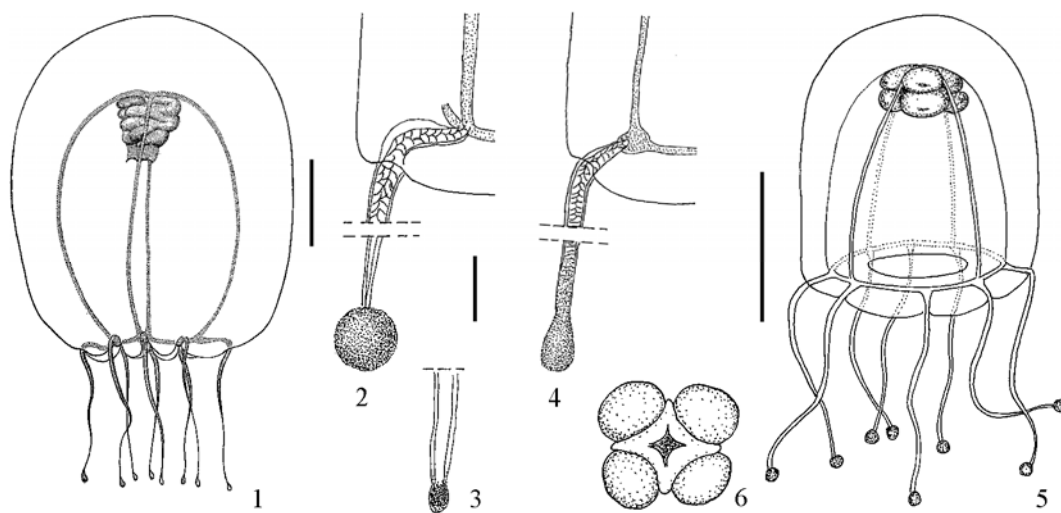
Type species: *Bythotia murrayi* Günther, 1903.

Diagnosis. Medusa with four simple or bifurcated radial canals, without centripetal canals; with or without secondary (rudimentary) tentacles, these entirely covered with nematocysts; gonads interradial, with transverse furrows; no ocelli.

Remarks. Only three *Bythotia* species occurs in South China Sea.

Bythotia depressa Naumov, 1960 (Figs 1–3, 5–6)

Bythotia depressa Naumov, 1960: 191–192, fig. 77; Kramp, 1968: 54, fig. 144; Arai & Brinckmann-Voss, 1980: 64; Brinckmann-Voss & Arai, 1998: 40–42, fig. 1a, 1c; Xu *et al.*, 2014: 281, fig. 140.



Figures 1–6. Bythotiaridae spp. 1–3, 5–6. *Bythotia depressa* Naumov, 1960. 4. *Protiaropsis anonyma* (after Brinckmann-Voss & Arai, 1998). 1. Mature medusa, side-view, bell 20 mm in height (after Naumov, 1960). 2. Adult, margin and tentacle tip (after Brinckmann-Voss & Arai, 1998). 3. Juvenile (after Brinckmann-Voss & Arai, 1998). 5. Side-view. 6. Mouth and gonads, oral view. Scale bars = 3.0 mm.

Material examined. Three specimens from the southern South China Sea, one specimen, 28 August 2011, station NT11012 (04°00'N, 113°00'E), depth 42.5 m; the other two specimens, 30 August 2011, station NT11015 (17°45'N, 111°15'E), depth 126 m. One specimen from the southern Taiwan Strait, station TD07101 (21°14'N, 116°27'E), depth 329 m, 31 January 2007; coll. Xiang Peng.

Description. Umbrella laterally flattened, 5–7 mm in height, 4.5–5.5 mm in width, with thick mesoglea, especially at apex; manubrium half length of bell cavity or less; gonad interradial, with varied degree of folding, usually with two or four transverse folds; eight tentacles thick at base, becoming very thin before terminal nematocyst clusters; without secondary tentacles; terminal nematocyst clusters of adult specimens mostly spherical, rarely ovate but still arising abruptly from a narrow portion of the tentacle; four unbranched radial canals, without centripetal canal.

Distribution. Southern of Taiwan Strait and southern of South China Sea; sea of Okhotsk, Kurile Islands, Bering Sea (Naumov, 1960), northeast and northwest Pacific (Arai & Brinckmann-Voss, 1980).

Remarks. *Bythotiar depressa* has frequently been confused with *Protiaropsis anonyma* (Maas, 1905) (= *Heterotiar anonyma*). Based on the literatures description of *B. depressa* and his own abundant material of *P. anonyma* from Papua New Guinea, Bouillon (1980) suggested this two species might be conspecific. However, Arai & Brinckmann-Voss (1980) recommended that they should be kept separate after comparing 232 specimens of *B. depressa* from the northeast and northwest Pacific to 30 specimens of *P. anonyma* from Papua New Guinea.

The two species are very similar. Each of them has four unbranched radial canals and tentacles (normally eight) with terminal nematocyst thickening. Although they are placed in different genera based on degree of gonad folding, the two species are very similar on it. Both of them may be smooth or show loose folding as the manubrium contracts.

However, *Bythotiar depressa* can be distinguished from the *Protiaropsis anonyma* by: 1) the terminal nematocyst clusters of the tentacles are usually spherical in adult, and always arise abruptly from a very thin portion of tentacle in the former, whereas they are more elongate in the latter; 2) radial canals of the former are twice the thickness of comparably size latter, but *B. depressa* does not show any thickening at the junction of radial and circular canals, whereas *P. anonyma* shows a slight thickening at that point; 3) the vacuolated portion of endodermal cells in the adnate tentacle base is thicker in *B. depressa* than in *P. anonyma* (Figs 2, 4).

***Eumedusa* Bigelow, 1920 New record to China**

Eumedusa n. g. Bigelow, 1920: 7; Kramp, 1961: 122; Bouillon *et al.*, 2006: 180.

Type species: *Eumedusa birulai* (Linko, 1913).

Diagnosis. Medusa with 4 unbranched radial canals and 4 or more centripetal canals arising from circular canal; gonads folded; tentacles of two kinds, large hollow ones with terminal knob, small ones without terminal knob; no ocelli.

***Eumedusa* sp. (Figs 7, 10)**

Material examined. One specimen (TIO 014), southern South China Sea, Station NNXW 12014 S01-14 (11°57'N, 110°16'E), 21 September 2012, sampling depth 2284–200 m, coll. Xiang Peng.

Description. Umbrella 5.5 mm in height, 7.5 mm in width, wider than the height, bell almost hemispherical, jelly thick, slightly thicker at apex; upper portion of manubrium broad, extended on 4 unbranched radial canals forming a cross as seen from above, manubrium short, about 1/4 of the height of bell cavity; mouth simple, quadrate shaped, with 4 small periradial lips; with 4 interradial and 8 adradial centripetal canals arising from circular canal, and all interradial and most of the adradial centripetal canals, joining base of manubrium, but some short and diverticular; with 4 periradial, 4 interradial, and 8 adradial tentacles, with periradial and interradial tentacles are all fully developed, but all adradial tentacles very short and developing; all tentacles without base swelling, but their basal part adnate to exumbrella, each tentacular base with red pigment spot; all full-length tentacles end in a terminal swelling and thus forming long club-shaped, with a distal concentration of nematocysts; tentacles shorter than full-length ones without distal swelling; without ocelli; gonads slightly folded and developing, on periradial region of the manubrium, and extended base of periradial radial canals.

Remarks. The medusa is placed under the genus *Eumedusa* because of following: 4 unbranched radial canals and 4 interradial and 8 adradial centripetal canals, tentacles of two kinds, large hollow ones with terminal knob, small ones without terminal knob, tentacle without base swelling; no ocelli.

Only one species, *E. birulai* (Linko, 1913), is reported under the genus *Eumedusa* (Bouillon *et al.*, 2006). The unnamed medusa is similar to *E. birulai* (Linko, 1913), but it can be separated from the latter by: 1) medusa with 8 adradial centripetal canals, and most of adradial centripetal canals joining the base of manubrium; 2) with 8 fully

developed tentacles with terminal knob of nematocysts and 8 short adradial tentacles without terminal knob; 3) all tentacular base with red pigment spot.

Although non-mature gonad was found in the preserved samples, the medusa from south of China Sea is a probably new species. As only one immature animal was found and the adult morphology of gonad in *Eumedusa* is irregularly folded, it seems advisable to defer creation of a new species name until the life cycle is known.

This genus is recorded from Chinese waters for the first time.

***Protiaropsis* Stechow, 1919**

Protiaropsis Stechow, 1919: 150; Schuchert, 2010: 338.

Heterotiar Maas, 1905: 19; Mayer, 1910: 107; Bigelow, 1919: 287; Kramp, 1961: 122; Bouillon *et al.*, 2006: 180.

Type species: *Protiaropsis anonyma* (Maas, 1905).

Diagnosis. Medusae with 4 simple radial canals; no centripetal canals; gonads interradial, no transverse folds; no secondary tentacles; no ocelli.

Remarks. This homonymic genus *Heterotiar* was proposed by Maas (1905), with the type species *Heterotiar anonyma* Maas, 1905 from the Malay Archipelago. Only two imperfect specimens were found by Maas (1905) during the Siboga Expedition. It was recorded in the eastern Pacific, northwest Pacific and western Atlantic by Bigelow (1909, 1913, 1918) and Vanhöffen (1911, based on one *anonyma* and four *minor* specimens, from the “Valdivia” collection). Then Stechow (1919) founded *Protiaropsis* to replace *Heterotiar* Maas, 1905, non *Heterotiar* Pomel, 1883 (Echinodermata (fossil)). However, the invalid name *Heterotiar* Maas, 1905 was still extensively used (Kramp, 1961; Bouillon *et al.*, 2006; Xu *et al.*, 2012). Until the 2010s, Schuchert (2010) renewed the valid status of *Protiaropsis* Stechow, 1919.

The present collection contains five specimens of the genus, one example of a new species, *pedunculata* **sp. nov.**, from the East China Sea, and four examples of a new species, *tetranema* **sp. nov.**, from South China Sea.

Key to the known species of genus *Protiaropsis* in China.

- 1 Manubrium with gastric peduncle, short and wide; 4 large mass-like gonads in interradial of manubrium; exumbrella with scattered cnidocysts..... *P. pedunculata* Xu, Huang & Guo, **sp. nov.**
Manubrium without gastric peduncle..... 2
- 2 With 4 marginal tentacles, no base swelling, with terminal knob of cnidocysts; with 4 perradial marginal bulbs, with a short endodermal process extending upwards from the basal bulbs reaching 1/4 of exumbrella height; 4 pads shaped gonads in interradial position on manubrium *P. tetranema* Xu, Huang & Wang, **sp. nov.**
With 8 or more tentacles 3
- 3 With 8–12 tentacles, each terminating more elongate, slight swelling..... *P. anonyma* (Maas, 1905)
With 16–24 tentacles, each terminating in a large cnidocyst cluster *P. minor* (Vanhöffen, 1911)

***Protiaropsis pedunculata* Xu, Huang & Guo, **sp. nov.** (Figs 8, 11–12)**

Material examined. Holotype (TIO 015), East China Sea, station DF083 (27°37'N, 123°41'E), depth 103 m, 24 July



Figures 7–9. Bythotiaridae spp., side view. 7. *Eumedusa* sp. 8. *Protiaropsis pedunculata* Xu, Huang & Guo, **sp. nov.** 9. *P. tetranema* Xu, Huang & Wang, **sp. nov.** Scale bars: 7 = 1.0 mm; 8–9 = 0.5 mm.

2009, coll. Donghui Guo .

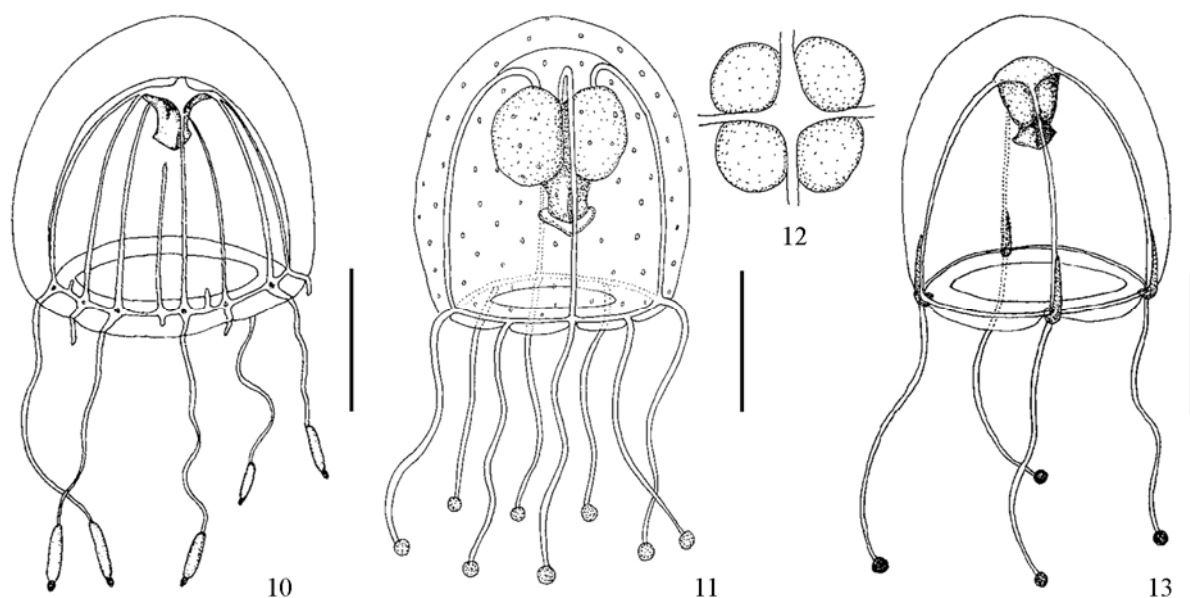
Diagnosis. Umbrella bell-shaped with scattered nematocyst clusters on exumbrella; manubrium on short and broad gastric peduncle; with 4 large, interradial gonads, no transverse folds.

Description. Umbrella bell-shaped, 1.0 mm in height, 0.8 mm in width, with rounded summit without marked apical process, jelly uniformly thick, with scattered cnidocysts on exumbrella; manubrium cylindrical, mounted upon the distal end of the short and broad gastric peduncle, about 1/2 length of bell cavity; with wide quadratic mouth and slightly flared lips; with 4 large gonads, one covering each interradial wall of manubrium, no transverse folds; with 4 simple radial canals and circular canal; no centripetal canals; 4 perradial and 4 interradial hollow primary marginal tentacles, without base swelling, but their basal part adnate to exumbrella, sunk into a narrow fissure between two marginal lobes, each tentacle with a terminal knob; no secondary tentacles; without ocelli; velum narrow.

Distribution. East China Sea.

Etymology. The specific name is from the Latin *pedunculata*, meaning peduncle, referring to the manubrium with gastric peduncle.

Remarks. The new species can be easily distinguished from the other species of *Protiaropsis* by: 1) manubrium mounted upon the distal end of the short and broad gastric peduncle; 2) exumbrella with scattered cnidocyst clusters; 3) with 4 large gonads, covering each interradial wall of manubrium, no transverse folds (see the key of *Protiaropsis*).



Figures 10–13. Bythotiaridae spp. 10. *Eumedusa* sp., side view. 11–12. *Protiaropsis pedunculata* Xu, Huang & Guo, **sp. nov.** 11. Side view. 12. Gonads, apical view. 13. *P. tetranema* Xu, Huang & Wang, **sp. nov.**, side view. Scale bars: 10=1.0mm; 11–13=0.5mm.

***Protiaropsis tetranema* Xu, Huang & Wang, sp. nov.** (Figs 9, 13)

Material examined. Holotype (TIO 016), southern of South China Sea, station NNXD 12066 S06-09, 8 July 2012. Paratype (TIO 017), one specimen, southern of South China Sea, station NNXW 12066 S06-09, 8 September 2012. All stations (03°40'N, 105°00'E), depth 70 m, coll. Peng Xiang.

Diagnosis. High, dome shaped exumbrella with scattered cnidocysts; 4 hollow perradial tentacles, no base swelling, with terminal knob of cnidocysts; with 4 perradial marginal bulbs with a short endodermal process, extending upwards from the basal bulbs reaching 1/4 of exumbrella height; 4 elliptic pads gonads in interradial position of manubrium.

Description. Medusa with bell-shaped umbrella, 1.0–1.2 mm in height, 0.7–0.9 mm in width, with slightly thicker jelly at apex, thinning towards the lateral walls; with scattered cnidocysts on exumbrella; manubrium pyramidal, no gastric peduncle, with a broad quadrate base, about 1/4 height of subumbrella cavity; mouth simple, with 4 slightly flared lips; gonads as 4 separated elliptic pads in interradial position on manubrium, may contact each other in perradial position; no transverse folds; 4 perradial hollow primary marginal tentacles, without base swelling, their basal part adnate to exumbrella, sunk into between two broad marginal lobes; tentacles thin and long, each with a terminal knob of cnidocysts;

no secondary tentacles; 4 radial canals and circular canal; four thick perradial endodermal processes of same size extending upwards from the basal bulbs, reaching approximately 1/4 of exumbrella height; without ocelli; velum broad.

Distribution. Southern South China Sea.

Etymology. The specific name is from the Latin *tetranema*, meaning tetra-tentacles, referring to four perradial marginal tentacles.

Remarks. The new species is described under the genus *Protiaropsis* because of following: four simple radial canals, no centripetal canals, tentacles without base swelling, no secondary tentacles, gonads interrarial, no transverse folds, no ocelli.

The major differences of the new species from the other species of *Protiaropsis* are: 1) manubrium without gastric peduncle; 2) umbrella margin with 4 hollow perradial tentacles, no base swelling, with terminal knob of cnidocysts; 3) with 4 perradial marginal bulbs with a short endodermal process extending upwards from the basal bulbs, reaching approximately 1/4 of exumbrella height; 4) 4 gonads elliptic-shaped pads in interrarial position on manubrium (see the key of *Protiaropsis*).

***Sibogita* Maas, 1905 New record to China**

Sibogita n. g. Maas, 1905: 17; Kramp, 1961: 124; Bouillon *et al.*, 2006: 180; Schuchert, 2009: 454.

Type species: *Sibogita geometrica* Maas, 1905.

Diagnosis. Medusa with 4 primary radial canals, branching repeatedly at various levels; no centripetal canals; with or without secondary tentacles and warts; gonads with 8 rows of transversely folded; no ocelli. Polyp unknown.

Remarks. The genus is a currently monotypic genus. Bigelow (1919) assumed that the side branches of the radial canals were actually centripetal canals. He therefore synonymized that the genus with *Calycopsis*. Kramp (1959) outlined the taxonomic history of the genus and contested Bigelow's view of the growth direction of the radial canals. Kramp thinks that the branching radial canals arise indeed through branching during ontogeny and he thus has an argument to maintain the genus. The diminution of the canal width towards the periphery is a good evidence to support this view. Schuchert (2009) assumed that neither known the polyp stage of *Calycopsis* nor of *Sibogita*, further discussions on the validity of *Sibogita* are premature.

This genus is recorded from Chinese waters for the first time.

***Sibogita geometrica* Maas, 1905 New record to China (Figs 14–16)**

Sibogita geometrica Maas, 1905: 17, pl. 3, figs. 16–18; Mayer, 1910: 186, fig. 99; Kramp, 1965: 49; Kramp, 1968: 57, fig. 151a–b; Schuchert, 2009: 455, fig. 8.

Sibogita geometrica occidentalis Kramp, 1959: 28, 129, pl. 2, figs. 2–3, text-figs. 4–5.

Calycopsis geometrica Bigelow, 1919: 290, pl. 40, figs. 5–7, pl. 41, fig. 2.

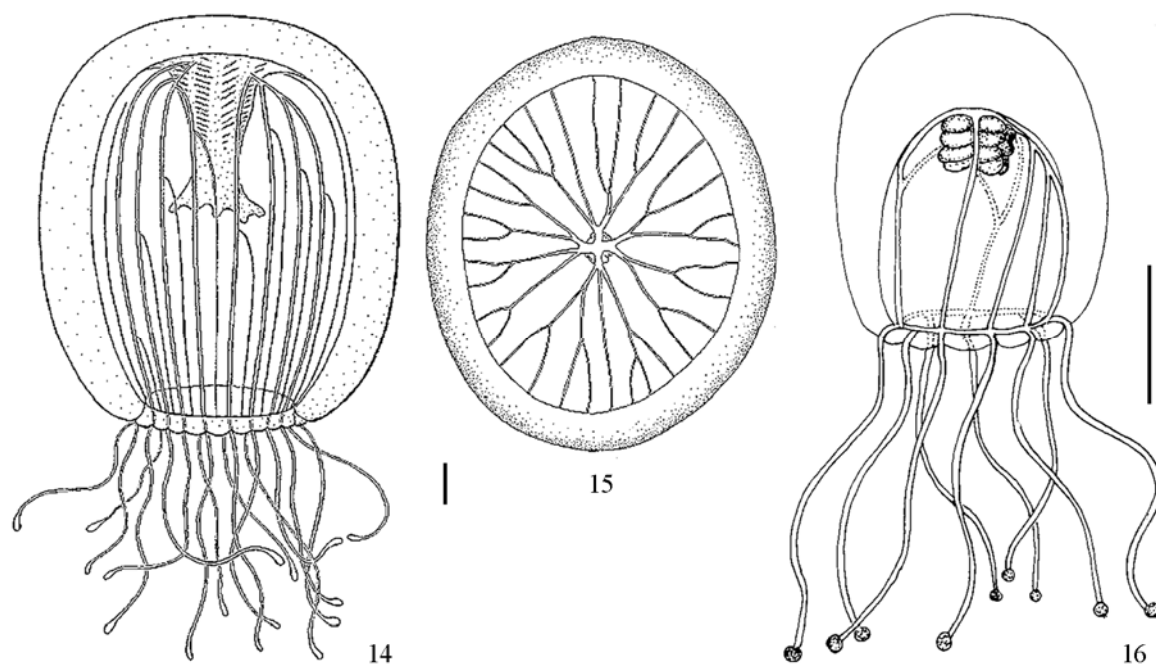
Material examined. One specimen, Beibu Gulf of South China Sea, station J62 (18°28'N, 108°34'E), depth 25 m, 31 July 2006, coll. Donghui Guo.

Description. Umbrella bell-shaped, 4.5 mm in height, 3.5 mm in width, with round dome, apex very thick, manubrium short small, about 1/3 length of subumbrellar cavity; mouth simple, circular; gonads in eight adradial rows, about four transverse folds in each row; with 4 primary radial canals, which somewhat irregularly branched, as seen from the figure they arise from the corners of the manubrium in four unequal groups; most of them bifurcated once or twice at various levels, some of them immediately before reaching the circular canal, occasional anastomoses occur; a few of them proceed undivided to the circular canal; no centripetal canals; altogether 9 canals join the circular canal; radial canals widening containing dark pigment granules; with 9 fully developed tentacles, without basal swellings, and no accumulations of pigment granules, but their basal part adnate to exumbrella, sunk into a narrow furrow between two marginal lobes; everyone of the fully developed tentacles placed opposite a radiating canal, and between two successive tentacles without small tentacles or wart-like protuberances; each tentacles with a terminal knob of cnidocysts, and no ocelli; velum narrow.

Biology. The species is a quite rare oceanic species. Bleeker & Van der Spoel (1988) proposed a diel vertical migration as all night samples were taken above depth 200 m and all day samples were taken bellow. Our specimen was found at 25 meters from the Beibu Gulf, northern South China Sea.

Distribution. Malayan Archipelago and tropical Indian Ocean (Maas, 1905; Bigelow, 1919), Bay of Biscay, Azores and mid-Atlantic (Kramp, 1959; Bleeker & Van der Spoel, 1988), Benguela current off South Africa (Pagès *et al.*, 1992), northern South China Sea.

Remarks. Our specimen has little different with Maas (1905). In original description, the single specimen has 32



Figures 14–16. *Sibogita geometrica* Maas, 1905. 14. Medusa from Pacific, side view, bell 38 mm in height, modified after Maas (1905) and Mayer (1910). 15. Medusa from Atlantic, aboral view, showing branching pattern of radial canals, after Winkler (1982). 16. Medusa from northern of South China Sea, side view, bell 4.5 mm in height. Scale bars: 15 = 3.0 mm, 16 = 2.0 mm.

canals and only 16 tentacles. In our specimen, there were 9 canals join the circular canal, and 9 fully developed tentacles, each of which placed opposite a radiating canals. On the other hand, the 4 primary radial canals somewhat irregularly branched. Thus, our specimen represents an intermediate form during its development. Although Bigelow (1919) observed the presence of pigment spot or ocelli at the base of the tentacles of the Philippine specimens, no such structures were observed in Maas's specimen and ours.

Kramp (1959) proposed that the Atlantic population slight differs from the Pacific one and then introduced the former as the subspecies *Sibogita geometrica occidentalis*. The differences to the nominate subspecies were given as a smaller bell-size, fewer gonadal folds, and radial canals dividing already close to the centre. After checking more specimens from the Pacific, Kramp (1965) synonymized the subspecies *occidentalis* with the nominal Pacific species. Some other authors (e.g. Winkler, 1982; Blecker & Van der Spoel, 1988) also confirmed this. Both forms are occurring in the Atlantic and the Pacific and they are treated as intermediate forms (Schuchert, 2009).

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References

- Arai, M. N., Brinckmann-Voss, A. 1980. Hydromedusae of British Columbia and Puget Sound. *Canadian Bulletin Fisheries and Aquatic Sciences*, 204: 1–192.
- Bigelow, H. B. 1909. Reports on the scientific results of the expedition to the eastern tropical pacific, in charge of Alexander Agassiz, by the U. S. Fish Commission steamer "Albatross" from October, 1904, to March, 1905. XVI The medusae. *Memoirs of the Museum of comparative Zoology at Harvard College*, 37: 1–243, pls. 1–48.
- Bigelow, H. B. 1913. Medusae and Siphonophora collected by the U.S. Fisheries Steamer "Albatross" in the Northwestern Pacific, 1906. *Proceedings of the United States National Museum*, 44(1946): 1–119, pls. 1–6.
- Bigelow, H. B. 1918. Some Medusae and Siphonophora from the western Atlantic. *Bulletin of the Museum of comparative Zoology of Harvard College*, 62: 363–442, pls 1–8.

- Bigelow, H. B. 1919. Hydromedusae, siphonophores and ctenophores of the “Albatross” Philippine Expedition. *Bulletin of the United States National Museum*, (100)1(5): 279–362, pls. 39–43.
- Bigelow, H. B. 1920. Medusae and Ctenophores from the Canadian Arctic Expedition, 1913–18. *Report of the Canadian Arctic Expedition 1913–18*, 8(H): 1–22.
- Bleeker, J., Van der Spoel, S. 1988. Medusae of the Amsterdam Mid North Atlantic Plankton Expeditions (1980–1983) with description of two new species. *Bijdragen tot de Dierkunde*, 58(2): 227–258.
- Bouillon, J. 1980. Hydroméduses de la mer de Bismarck (Papouasie, Nouvelle-Guinée). Partie III: Anthomedusae - Filifera (Hydrozoa-Cnidaria). *Cahiers de Biologie Marine*, 21(3): 307–344.
- Bouillon, J., Gravili, C., Pagès, F., Gili, J.-M., Boero, F. 2006. An introduction to Hydrozoa. *Mémoires du Muséum national d'Histoire Naturelle*, 194: 1–591.
- Brinckmann-Voss, A., Arai, M. N. 1998. Further notes on Leptolida (Hydrozoa: Cnidaria) from Canadian Pacific Waters. *Zoologische Verhandelingen*, 323(31): 37–68.
- Du, F.Y., Xu, Z.Z., Huang, J.Q., Guo, D.H. 2012. Studies on the medusae (Cnidaria) from the Beibu Gulf in the northern South China Sea, with description of three new species. *Acta Zootaxonomica Sinica*, 37(3): 506–519.
- Günther, R. T. 1903. Report on the Coelenterata from the intermediate waters of the N Atlantic, obtained by Mr. George Murray during the Cruise of the ‘Oceana’ in 1898. *Annals and Magazine of Natural History*, (7)11: 420–430, pls. 9–10.
- Kramp, P. L. 1959. The Hydromedusae of the Atlantic Ocean and adjacent waters. *Dana-Report*, 46: 1–283.
- Kramp, P. L. 1961. Synopsis of the medusae of the world. *Journal of the Marine Biological Association of the United Kingdom*, 40: 1–469.
- Kramp, P. L. 1965. The Hydromedusae of the Pacific and Indian Oceans. *Dana-Report*, 63: 1–162.
- Kramp, P. L. 1968. The Hydromedusae of the Pacific and Indian Oceans. Sections II and III. *Dana-Report*, 72: 1–200.
- Li, A.S., Chen, Q.C. 1991. The hydromedusae in the waters around the Nansha Islands – the species composition, faunistic characters and zoogeography of Hydromedusae around the Nansha Islands waters. In: *Symposium of Marine Fauna and Zoogeography of the Nansha Islands Waters*. China Ocean Press, Beijing, pp. 1–63.
- Maas, O. 1905. Die Craspedoten Medusen der Siboga-Expedition. *Siboga-Expedition*, 10: 1–84.
- Mayer, A. G. 1910. *Medusae of the world. Volume I–II the Hydromedusae*. Carnegie Institution, Washington. 498pp.
- Naumov, D. V. 1960. Hydroids and Hydromedusae of the USSR. *Zoological Institute of the Academy of Science of the USSR*, 70: 1–585, 30 pls.
- Pagès, F., Gili, J. M., Bouillon, J. 1992. Medusae (Hydrozoa, Scyphozoa, Cubozoa) of the Benguela Current (southeastern Atlantic). *Scientia Marina*, 56(Supl. 1): 1–64.
- Schuchert, P. 2009. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Filifera Part 5. *Revue Suisse de Zoologie*, 116(3–4): 441–507.
- Schuchert, P. 2010. The European athecate hydroids and their medusae (Hydrozoa, Cnidaria): Capitata Part 2. *Revue Suisse de Zoologie*, 117(3): 337–355.
- Stechow, E. 1919. Zur Kenntnis der Hydroidenfauna des Mittelmeeres, Amerikas und anderer Gebiete, nebst Angaben über einige Kirchenpauper’sche Typen von Plumulariden. *Zoologische Jahrbücher, Systematik*, 42(1–3): 1–172.
- Vanhöffen, E. 1911. Die Anthomedusen und Leptomedusen der Deutschen Tiefsee Expedition 1898–1899. *Wissenschaftliche Ergebnisse der deutschen Tiefsee Expedition Valdivia*, 19: 193–233.
- Winkler, J. T. 1982. The Hydromedusae of the Amsterdam Mid North Atlantic Plankton Expedition, 1980 (Coelenterata, Hydrozoa). *Beaufortia*, 32: 27–56.
- Xu, Z.Z., Huang, J.Q. 1994. A new genus and two new species of Hydroidomedusae from Taiwan Strait. *Journal of Xiamen University (Natural Science)*, 33(Sup.): 149–153.
- Xu, Z.Z., Huang, J.Q. 2006. On new genus, species and record of Laingiomedusae and Anthomedusae in Fujian Coast (Cnidaria, Hydroidomedusae). *Journal of Xiamen University (Natural Science)*, 45(Sup. 2): 233–249.
- Xu, Z.Z., Zhang, J.B. 1978. On the hydromedusae, siphonophores and scyphomedusae from the coast of the east Guangdong Province and south Fujian Province, China. *Journal of Xiamen University (Natural Science)*, 17(4): 19–63.
- Xu, Z.Z., Huang, J.Q., Guo, D.H. 2008. Six new species of Anthomedusae (Hydrozoa, Hydroidomedusae) from the Beibu Gulf, China. In: Hu, J.Y., Yang, S.Y. (ed.). *Symposium on Oceanography of the Beibu Gulf I*. China Ocean Press, Beijing. pp. 209–221.
- Xu, Z.Z., Huang, J.Q., Lin, M., Guo, D.H., Wang, C.G. 2012. Ecological zoogeography of Hydrozoa (excluding Siphonophora) in the Chinese inshore (Cnidaria). In: Lin, M., Wang, C.G. (ed.) *Proceedings of the 1st Mainland and Taiwan Symposium of Marine Biodiversity Studies*. China Ocean Press, Beijing. pp. 273–294.
- Xu, Z.Z., Huang, J.Q., Lin, M., Guo, D.H., Wang, C.G., 2014. *The Superclass Hydrozoa of the Phylum Cnidaria in China*. China Ocean Press, Beijing. 945pp.